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COMMENTARY

ASPECTS OF LOVE

There is no global agreement on the number of frames per second that should be captured and/or presented in high definition television (HDTV). There is no global agreement about how many scanning lines it should have. There's not even a consensus as to whether it should have interlaced (TV-like) or progressive (computer-like) scanning. But, until last year, there *seemed* to be global agreement on at least one aspect of advanced television (ATV): its aspect (or shape).

The aspect ratio (AR) of an image is the ratio of its width to its height. The earliest 35mm film frame was one inch wide and 3/4 inch high, and, although the dimensions have changed somewhat over the years, that 4:3 or 1.33:1 AR remained the primary shape of film for more than half a century. When the National Television System Committee (NTSC) worked out the parameters of video signals in the United States, it selected a 4:3 AR specifically because it matched motion picture technique.

That selection was made at the beginning of the Forties. By the beginning of the Fifties, TV was adversely affecting movie theater attendance, so the motion picture industry looked for ways to make movie images look different from those on TV. Stereoscopy (3-D) was one possibility; wider aspect ratios was another.

Three-D quickly became known as a gimmick, but widescreen stuck, and, to this day, the vast majority of U.S. feature films are exhibited in a ratio wider than 1.33:1. Unfortunately, exactly how much wider is impossible to say. Some films are made in a roughly 2.4:1 AR, others at 1.85:1. As few movie theaters offer projected images precisely matching viewfinder markings, films might be shown at those ratios, 1.75, 1.66, variations on those, or even 1.33:1.

Although theatrical aspect ratios have ranged from more than 4:1 to less than 1:1, the widest movie ratio in common use at the time of the beginning of HDTV standardization talks in the Eighties was 2.35:1, and the narrowest was TV's 1.33:1. A mathematical calculation of the ratio requiring the least cropping of any shape between 1.33:1 and 2.35:1 yields 1.77:1. And a tiny upward adjustment of that figure (to 1.7777...) makes it 16:9 or 4:3 times 4:3 (the 2.35 AR of widescreen film can be considered 4:3 times 4:3 times 4:3), a figure that permits one large 4:3 image to appear on a screen with three little 4:3 images stacked next to it.

Those and other advantages seen for 16:9 brought about global agreement. In this country, it was reported at the 1985 SMPTE winter conference by the chair of the working group on high definition electronic production (WGHDEP) that "At its May 4, 1984 meeting, the SMPTE WGHDEP voted unanimously to adopt the 1.77 value as its baseline value for all electronic production. Five cinematographers, all members of the WG, spoke favorably of the concept."

Later, in 1988, the Federal Communications Commission's Advisory Group on Creative Issues of the Planning Sub-Committee of the Committee on Advanced Television Service also commented on 16:9 playback from a disk drive should be dealt with.

Participants were exposed to telecommunications and computing issues that may affect their work, but they were also exposed to the fact that experts disagree about the solutions to the problems. And it wasn't only in the seminar and conference that questions were raised.

Introducing the first official demonstrations in a program called "One Size Does Not Fit All," running concurrently with the technical paper sessions, conference co-chair Peter Symes, of the Grass Valley Group, said that the demonstrators were known to be passionate about their pet issues but had been asked to tone down their ardor and offer dry presentations. As a result, viewers of the demonstrations were dispassionately exposed to different forms of scanning, different resolutions, different display and pixel aspect ratios, different display and program frame rates, different forms of compression, different forms of transmission, and even different ways of compensating for these differences without ever being told which was—even in the view of the demonstrators—the right one.

Other demonstrations covered still more aspects of video compression, one taking so long to run through all of its different possibilities that at least one viewer complained of having forgotten the look of early versions by the time the later ones were shown. Alas, the concurrent nature of the demonstrations and the papers made it difficult for participants to attend everything the conference had to offer.

At one point, participants even had to choose between coffee and the Internet. Proselytizing for the global communications network as an information resource that all conference participants should be using, conference co-chair Charles Poynton, of Sun Microsystems, not only delivered a paper on the subject but also set up a demonstration in the same room as the "One Size Does Not Fit All" demos. When he felt that wasn't drawing enough converts, he moved the Internet demonstration to the room where conference coffee breaks were held. If participants made a bee line for the computer every time a break was called, they had a chance to

and reported that "The difference between the 1.85 aspect ratio (the dominant feature film format in the United States) and ATV's 1.77 is negligible." At the time of that report, the committee was said to include such creative members as Shelly Duvall and Jim Henson, as well as other directors, producers, writers, production designers, executives from such major film studios as Columbia Pictures, Disney, MGM-UA, Paramount, and Universal, and even motion picture camera manufacturer Panavision's Director of Technology.

Last year, the American Society of Cinematographers (ASC) called such reports into question, however, saying that the creative community was not, in fact, consulted about the selection of a picture shape. According to the ASC, an aspect ratio of 2:1 is more appropriate to ATV displays than is 16:9. The ASC AR can also be expressed as 16:8, making the dispute seem like much ado about very little, but both defenders and detractors get very passionate about their arguments.

At the SMPTE winter conference this year, demonstrations and a paper by Gary Demos, of DemoGraFX in Santa Monica CA, raised a second aspect ratio issue in promoting the ASC's 2:1. The Demos demos involved stretching digital pictures by a factor of 1.5:1 to create the desired 2:1 AR. Unfortunately, that means that the *pixel* aspect ratio (the shape of individual picture elements) is 1.5:1 requiring extensive processing for image rotation.

Another aspect-ratio-related issue was demonstrated by VIDEOGRAPHY's own Craig Birkmaier. Many people object to the form of translation of widescreen movies to TV called "pan & scan," wherein moves and cuts never intended in the original are introduced to help make the action visible in the narrower frame. Indeed, part of the ASC proposal is that all films be distributed digitally in their original aspect ratios, giving consumers the option of shrinking, distorting, or "panning and scanning" images to get them to fit narrower displays.

Unfortunately, there exist huge libraries of 4:3 programming, whether in the form of television shows or old movies, that are too *narrow* for a widescreen display, and the ASC's wider than 16:9 proposal only makes the problem worse. Birkmaier may have offered the engineers their first demonstration of "*tilt* and scan," the sort of image manipulation that may be used in the future to accommodate less-than-widescreen imagery on a wide screen.

No single display aspect ratio can be ideal for all imagery, a conclusion that some may have reached from the title of the Demos and Birkmaier demonstrations: "One Size Does Not Fit All." And it's far from clear that wider is better. Experimental evidence suggests that the most preferred aspect ratio may be 1.62:1, closer to the ATV 16:9 than the ASC 2:1. And then there's St. Matthew:

"Wide is the gate, and broad is the way, that leadeth to destruction, and many there be that go in thereat. Strait is the gate, and narrow is the way, which leadeth unto life, and few there be that find it."

Of course, that could be another way of saying that widescreen action movies with lots of demolition are preferred by the masses to 4:3 art films scrutinizing life. —MARK SCHUBIN

explore ("surf") the Internet, but, if they did, they lost their chance for a jolt of caffeine.

A similar choice faced participants at the Welcoming Reception. As is traditional in winter SMPTE conferences, a party was held for all participants after the first day's formal technical sessions. The last time the winter conference was held in San Francisco, the reception venue was the Cable Car Barn, the source of motive power for the city's rolling landmarks.

This year, the party was held in a room adjacent to that of the technical sessions, and it featured HDTV pictures in a 16:9 aspect ratio, projected by a General Electric 3LV system. If participants ate, drank, and networked, as they have normally done at such events in the past, they risked missing seeing the picture defects being projected, but, even when they *did* see those defects, it was difficult to find someone who could explain what had caused them—cameras, recorders, the compression system used to allow the images to be transmitted to the hotel as part of Pacific Bell's "Cinema of the Future" service, or some process of the transmission and switching.

Pacific Bell arranged the demonstration because they felt it important to involve SMPTE members in their work, but, as came out at the conference, there are those who think the deliberative (and, therefore, relatively slow) nature of SMPTE's standards work may leave it in the dust in today's fast-paced digital world. A paper on the mastering of feature films to a compression format, for example, called for standards to identify the 25 different possible conditions of frame matching when material that was shot on film is edited on video. If SMPTE doesn't act quickly, however, the paper suggested, the matter may be decided by a technical group of the World Airline Entertainment Industry working on the use of digital playback media for video presentations on commercial flights.

And should those media be disk or tape? A paper called "Digital Acquisition Without Compromise" addressed that question and ended up favoring tape. Sony, which seems to have a vested interest in tape compared to, say, manufacturers of nonlinear editing systems, has previously demonstrated and commented on

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WIDER IS...SMALLER?

Sometimes it seems that there is no agreement whatsoever about the parameters of future television systems. Even the U.S. Grand *Alliance* of high-definition television (HDTV) proponents could agree only on a range of possible image characteristics with different amounts of detail resolution and different forms of scanning. No one outside the U.S. has yet adopted any of the Grand Alliance parameters. Such HDTV production as is taking place in this country or elsewhere also has different specifications. And, of course, there remains a question in many minds as to whether future television systems should be HDTV at all.

Still, until recently, there was one glimmer of hope. The Grand Alliance, European and Japanese HDTV interests, manufacturers of all currently sold HDTV equipment, the standards of the Society of Motion Picture and Television Engineers (SMPTE)—even proponents of advanced television systems without increased detail definition—all agreed on one thing: the shape of the screen. It was to be 16 units wide to nine tall, a ratio of approximately 1.78:1.

In 1994, however, the American Society of Cinematographers (ASC) issued a call for screens to have an aspect ratio (shape) of two units of width to one unit of height. The ASC position is that 2:1 (16:8) is better for movies than is 16:9. A paper called "The History of the Perfect Aspect Ratio," presented at World Media Expo last month in New Orleans, examined the controversy in great detail.

The paper noted that, perhaps unbeknownst even to its supporters, the 16:9 ratio has historical roots. It was actually first adopted by SMPTE's predecessor (the Society of Motion Picture Engineers) in 1930 as an optimum *movie theater* screen shape suggested by the Academy of Motion Picture Arts and Sciences. In 1953, the ratio was again proposed as a "standard" screen shape for movie theaters.

The paper also stated that ASC members actively opposed a 2:1 aspect ratio in 1930, preferring something narrower. A 1971 book referenced in the paper (*Behind the Camera, the Cinematographer's Art*, by Leonard Maltin) quoted cinematographer Lucien Ballard as saying "I like 1.75, 1.8, almost the old screen ratio best," figures that bracket 16:9's 1.78:1.

Perhaps the biggest surprise of the paper, however, came during an analysis of how different shapes of imagery would fare on different shapes of displays. As the ASC's Rob Hummel notes in the current edition of the *American Cinematographer Manual*, "1.85 is far and away the most common aspect ratio for motion pictures filmed in the United States."

At roughly 1.78:1, a 16:9 display screen is considerably closer in shape to a 1.85:1 movie than is a 2:1 display screen. For screens of equal diagonal measurement (a rough indicator of display cost), a 16:9 screen would show a 1.85:1 movie approximately 12 percent larger than would a 2:1 screen. On any size screen, a 16:9 display would have only half as much blank screen area when showing a 1.85:1 movie as would a 2:1 display. And, for any given amount of display memory, a 16:9 screen would offer a 1.85:1 movie with greater detail than would a 2:1 screen. Thus, for the most common shape of today's U.S. movies, a 16:9 display would offer bigger and sharper pictures with less wasted space than would a 2:1 display.

Of course, 2:1 screens fare better when comparisons are made to the 2.2:1 aspect ratio of a 70mm movie or the 2.4:1 of an anamorphically squeezed and expanded (CinemaScope-like) movie. They also fare worse still for narrower aspect ratio programming like TV shows, old movies, and many European films.

Both 16:9 and 2:1 are compromises, however. The 16:9 shape was derived from a mathematical calculation to find a figure that would cause the least amount of degradation or loss for all aspect ratios between the extremes of 1.33:1 (TV and old movies) and 2.4:1 (CinemaScope).

Suppose neither movies nor television had yet been invented, however. Is there a basis for picking a particular shape as the most perfect for the display of moving images? The paper's research went back as far as 4,750 B.C. It examined the preferences of cinematographers and directors. It went through psychological testing and the physiological basis of human vision.

After all of that, and more, the paper came to the only possible conclusion about a single perfect aspect ratio. There is none.—MARK SCHUBIN

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magnetic-disk-based editing sounded crazy 25 years ago.

Sometimes, like nonlinear editing, concepts require gestation time before emerging. It's rare that, like camcorders or digital effects, new concepts take off immediately, and, even when they do, the companies that introduced them, like RCA and Vital, are sometimes left in the dust.

What will prove to be NAB 95's camcorder? What will be its nonlinear editor? What will be its "Octoplex?" What will be its Type M? Even when all the facts are known, decision making can be tough. The CD had already been introduced when Nitty Gritty demonstrated its LP cleaners at NAB 84.

Alas, these columns may not prove helpful. The first, published exactly 19 years ago, in April 1976, covered such now-popular concepts as direct satellite broadcasting, CCD cameras, liquid crystal TV sets, surround sound, autofocus, fiber optics, low-light-level videography, frame grabbers, electronically transmitted program guides, video-on-demand, and closed-captioning in different languages. The same column, however, also discussed electronic holography and mind-controlled lensless cameras, concepts that, at best, have not completed their gestation periods.

A perfected technology, unfortunately, is no guarantee of success, either. Laser videodisc players work extremely well and offer pictures superior to those of VHS, but, despite more than 16 years of effort, the technology has yet to achieve mass penetration of consumer households.

Consumer and professional videographer technology has a great deal of inertia. Just because something is better or cheaper it will not instantly cause the industry to change. Sir Isaac Newton described the situation perfectly more than three centuries ago: Things don't change unless they're forced to.

Of course, even the words of Newton sometimes had a long gestation period. In a letter in 1675, he wrote the oft-quoted, "If I have seen further it is by standing on the shoulders of giants." More than half a millennium before Newton, however, John of Salisbury quoted Bernard of Chartres as saying, "we are like dwarfs on the shoulders of giants, so that we can see more than they...."

THE SHAPE OF THINGS TO COME

Considering the shape and nature of the binocular-visual field of view, can there be deduced any preferred aspect ratio for television pictures? Are there any other theoretical bases for the selection of any particular preferred aspect ratio?"

Those were the first two questions considered by Panel 2 of the NTSC, the group responsible for investigating the subjective aspects of television for the standard that would be issued in 1941. The committee took its work seriously.

Panel 1 (system analysis) had identified 31 existing television systems around the world, 19 with a 4:3 aspect ratio, seven with 5:4, two with 3:4 (vertically oriented pictures), one each with 11:8 and 6:5, and one not specified. Panel 2 investigated those; such aspects of vision as isopters (intensity perception contours), color fields, visual acuity, fusional areas, fields of fixation (with and without eye movement), foveal shape, and optical illusions; and art dating back as far as 4750 B.C. in the fields of architecture, drawing, painting, photography, and sculpture.

Despite the facts that early TV patents proposed spiral scanning, lenses create round images, and the shapes of picture tube faceplates were then also round, the NTSC rejected round pictures. The most efficient rectangular shape in terms of filling a picture tube's faceplate was also rejected: "A square is not particularly pleasing to the eye."

Though it was noted that vertically oriented pictures are more suitable for faces, full-length figures, and small groups, and that such vertically oriented images are also easier to handle for sweeping the electron beam horizontally across the faceplate, the panel rejected tall and narrow pictures. "Since most of man's activities occur in a horizontal plane, it is reasonable that there should be more freedom of motion horizontally than vertically," it reported. "Thus, if the rectangle has its longer side horizontal, it will best accommodate average scenes in which action takes place."

But what shape horizontal rectangle? The panel investigated such aspect ratios as 1.41:1, 1.73:1, 2:1, and 2.24:1 (the square roots of 2, 3, 4, and 5, respectively), but found 1.62:1, a ratio known as The Golden Section, to be seemingly the most preferred. "A variety of experiments in the field of experimental aesthetics would dictate that the 'golden section,' or an approximation to it, would be most satisfactory." Alas, the panel didn't want to waste *too* much of the surface of the picture tube. The report continued, "Although this might be of some importance for merchandising, it could hardly be a major determinant for the strictly scientific solution of the problem at hand."

Ultimately, the NTSC deferred to the art of cinematography, adopting a 4:3 aspect ratio for two reasons: "[it] has all advantages found in motion picture practice" and "[it] permits scanning of motion picture film without waste of screen area or distortion of the aspect ratio."

Interestingly, earlier research used the exact same logic to come to a different conclusion. "In determining the proportions of the picture, it seems logical to consider the standards of sound motion picture film, since it is believed that transmission of sound motion pictures may form a considerable part of television programs," the authors of "The Selection of Standards for Commercial Radio Television" wrote in the *Proceedings of the Institute of Radio Engineers* in September of 1929. Unfortunately, film-frame shapes have not remained constant for the past 100 years. Just as movies would become wider 11 years after the NTSC standard was issued, they were *narrower* 11 years before. The IRE paper continued, "Those proportions are in the ratio of 5 to 6." — MARK SCHUBIN